

CLAIMS

1. A digital modem, comprising :
a modulation circuit for outputting respectively as modulation signals,
a signal $h[k]$ whose amplitude frequency characteristic is constant, and the
5 phase thereof varies in proportion to the square of the frequency (namely, group
delay proportional to the frequency),
when a transmission symbol is 1, and
a signal $h[-k]$ which is the signal $h[k]$ right and left inversed on the time axis,
when a transmission symbol is -1 ; and
10 a demodulation circuit for determining the difference between,
the square thereof after linear convolution of said modulation signal and the
signal $h[-k]$ which is the sequence $h[k]$ right and left inversed on the time axis,
and
the square thereof after linear convolution of the modulation signal and the
15 sequence $h[k]$,
for modulation / demodulation of $1 / -1$ binary signal.

2. The digital modem of claim 1, wherein an analogue circuit is adopted
for output processing of a modulation signal in said modulation circuit and / or
convolution processing of a modulation signal in said demodulation circuit.

- 20 3. The digital modem of claim 1, wherein :

said signal $h[k]$ is a series h whose discrete Fourier transform is

$$\text{DFT}(h[k]) = \begin{cases} \cos \beta n^2 + j \sin \beta n^2 & (0 \leq n \leq L/2) \\ \cos \beta (L-n)^2 - j \sin \beta (L-n)^2 & (L/2 < n < L) \end{cases}$$

where, L is the length of the series h , the range of k is $0 \leq k < L$, and β is a

- 25 constant taking a value other than 0.

4. The digital modem of claim 1, wherein :

said signal $h[k]$ is a sequence h making :

$$h[k] = 1 - 2\text{mod}_2 \left[\frac{k^2}{2L} \right]$$

where, L is the length of the series h, the range of k is $0 \leq k < L$, $\text{mod}_2(x)$ is the remainder of division of x by 2, and x is an integer not exceeding x.

- 5 5. The digital modem of claim1, wherein two sweep signals used for modulation of said binary signal and two FIR filter coefficients used for demodulation are defined as

$$y_1[n] = \sin(\alpha n^2 + \beta n - \gamma) \quad (0 \leq n < N)$$

$$y_2[n] = y_1[N - 1 - n] \quad (0 \leq n < N)$$

- 10 where N is length of sweep signal $y_1[n]$, $y_2[n]$, and α, β, γ are arbitrary constants.

6. The digital modem of claim 1, wherein two sweep signals used for modulation of said binary signal are defined as equation(01)

$$y_1[n] = \sin(\alpha n^2 + \beta n - \gamma) \quad (0 \leq n < N)$$

- 15 $y_2[n] = y_1[N - 1 - n] \quad (0 \leq n < N)$, and,

two FIR filter coefficients used for demodulation thereof are defined as equation(02)

$$h_1[n] = \begin{cases} 1 & (\text{if } 0 \leq y_1[n]) \\ -1 & (\text{if } y_1[n] < 0) \end{cases}$$

- 20 $h_2[n] = h_1[N - 1 - n] \quad (0 \leq n < N)$,

where N is length of sweep signal $y_1[n]$, $y_2[n]$, and FIR filter coefficient $h_1[n]$, $h_2[n]$, and α, β, γ are arbitrary constants.